# *Chemical Hand Protection Training*

***Guidance for Shipboard Maintenance Personnel, Work-Center Supervisors, Safety Officers, Hazardous Material Coordinators and Medical Department Personnel***

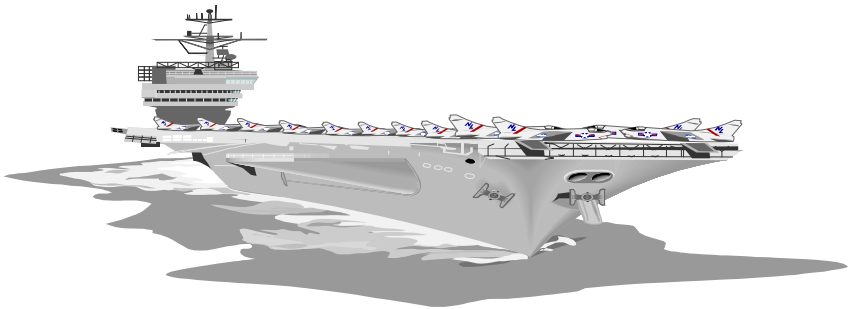
Training Developed by the
Navy PPE Working Group
and
Naval Safety Center
Last Updated: 05 March 2013

NAVY

FIRE EXTINGUISHER

# Objectives:

- This presentation is designed to
  - Provide essential information on chemical resistant gloves for:
    - Maintenance personnel
    - Work Center Supervisors
    - Safety Officers
    - Hazardous Materials Coordinators
    - Medical Department Representatives
  - Correct common misunderstandings and ineffective use of chemical resistant gloves



# Navy PPE Training Requirements

- *OPNAVINST 5100.23G, paragraph 2013(a)*
  - Activities shall provide training to each employee who is required to use PPE to include at least the following:
    (1) When PPE is necessary
    (2) What PPE is necessary
    (3) How to properly don, doff, adjust and wear PPE
    (4) The limitations of the PPE
    (5) The proper care, maintenance, useful life, storage and disposal of the PPE
    (6) Ability to recognize that defective or damaged PPE shall not be used

- *OPNAVINST 5100.19E, paragraph B1202(c)*
  - Division officers shall ensure that assigned personnel are adequately trained on the type and proper use of PPE required at their work stations…

# How to Use This Training

- Be sure to review the instructor notes contained within this training as they provide important additional details

- The most current version of this training can be downloaded from
  - Naval Safety Center's Safety Officer Training Materials web page
    (see Notes)
  - NAVSEA's Maritime DC and PPE Information Center (see Notes)

# First Things First

- Before working with chemicals, always check
  - Maintenance Requirement Card (MRC)
  - The product Material Safety Data Sheet (MSDS)/Safety Data Sheets (SDS)
  - The command Industrial Hygiene (IH) survey report
- Receive training on applicable PPE

# PPE Should Be the Last Resort!

- Problems with PPE
  - It can fail
  - Sailor can forget to wear it
  - It can be worn improperly

- Can the Sailor be protected by other means (see notes)?
  - Substitution
  - Engineering Controls
  - Administrative Controls

- If the above controls are not feasible or not protective enough, then PPE is appropriate

# Hand Protection and Gloves

- Many different types of gloves
  - Chemical resistant
  - Heat resistant
  - Cold resistant
  - Cut resistant (Kevlar)
  - Electrical insulating

- We will concentrate on chemical protective gloves in this training

# Hand Protection- Gloves

- Objective is protection from chemical hazards
  - Chemical burns
  - Absorption through skin
    - Local effects
      - Cracking, drying, dermatitis
    - Systemic effects
      - Kidney, liver, central nervous system, cancer

# *IMPORTANT!!*

- No glove is good for <u>all</u> hazards!!!
  - You must know what you're working with and have a glove made from the appropriate protective material
- Some gloves may provide great protection against some chemicals, but provide poor protection from others
- Thickness (mils) plays a part as well
  - A "mil" is a thousandth of an inch

# Just How Important Can It Be?

- Dartmouth University Example (link in notes section)
  - PhD Research Chemist
  - Dimethylmercury exposure
  - Just a few drops on surgical latex glove (15 sec exposure)
  - Within 5-6 months symptoms included:
    - Tremors (mouth, tongue, face, head), memory loss, tunnel vision, fatigue, weakness
  - Condition continued to worsen
  - Coma 6 months post-exposure
  - Death 10 months post-exposure

# Gloves

- Manufacturers make chemical protective gloves from many different materials
  - Nitrile
  - Neoprene
  - Butyl (synthetic) rubber
  - Polyvinyl Chloride (PVC)
  - Natural latex rubber
  - Multi-layer laminate
  - Polyvinyl alcohol (PVA)
  - Viton® rubber
  - … and several others
- How do we know which to choose?

# NSTM 670 Vol. 2

*Hazardous Materials User's Guide (HMUG)*

- Contains PPE recommendations and information for 20 chemical groups
  - Eye and face protection
  - Gloves
  - Clothing
  - Foot protection
  - Respiratory protection
- Previously was OPNAVINST 5100.28
  - HMUG was incorporated into NSTM 670 in June 2012

# *Chemical Hand Protection Selection Matrix*

- The Navy PPE Working Group developed a Chemical Protective Glove matrix based on the NSTM 670 Hazardous Material User's Guide (HMUG)

- If the Maintenance Requirement Card (MRC) required glove is unavailable, the matrix helps maintenance personnel and their supervisors select a good alternative

# Chemical Protective Glove Matrix

- "The Matrix" contains helpful information
  - Instructions on how the matrix should be used
  - Photos of various glove types
  - NAVSEA's Standard PMS Item Name (SPIN)
  - National Stock Number (NSN) information
  - Comparison of protection capabilities of various glove types against many common chemical hazards
- The matrix can be downloaded from
  - Naval Safety Center Personal Protective Equipment webpage (see Notes)
  - NAVSEA's Maritime DC and PPE Information Center (see Notes)

| NSTM 670 (Vol. 2) HMUG Chemical Group # | NSTM 670 (Vol. 2) HMUG Chemical Group Name | NSTM 670 (Vol. 2) HMUG Hand Protection (Chemical) Recommendation (See Note 1 below) | Chemical Resistant Glove Type | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nitrile (Green "OTTO Fuel") Gauntlet Gloves | Neoprene Gloves | Butyl (Synthetic) Rubber "Toxicological Agents Protective" Gloves | PVC Coated Rubber (Chemical/Oil Protective) Gloves | Black Natural Latex Rubber "Industrial" Gloves | 8-mil Disposable Nitrile Gloves | 4-mil Disposable Nitrile Gloves | Multi-Layer Laminate Gloves |
| | | | SPIN: 02086 | SPIN: TBD | SPIN: 02085 | SPIN: 00517 | SPIN: 00525 | SPIN: 02826 (8 mil thick) | SPIN: 17934 (4 mil thick) | SPIN: TBD |
| Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs. | | | | | | | | NOTE: Incidental (Splash) contact only Replace with new glove if contamination occurs | | NOTE: Recommend wearing with a disposable nitrile glove over-layer |
| Group 1 | Acids | Acid-Resistant | More Info | More Info | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 2 | Alkalies/Bases/Caustics | Rubber | More Info | More Info | Y | Y | Y | More Info | More Info | Ok (for all) |
| Group 3 | Detergents/Soaps | Rubber | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
| Group 4 | Photographic Chemicals | Rubber | More Info | More Info | Y | Y | Y | More Info | More Info | Ok (for all) |
| Group 5 | Adhesives | Neoprene or Rubber | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 6 | Cleaning Compounds | Rubber | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
| Group 7 | Aerosols | Neoprene | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 8 | Paint Materials (Oil-Based) | Neoprene for Oil-Based Paints<br>Any Protective Glove for Water-Based | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 9 | Solvents | Solvent-Resistant | More Info | More Info | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 10 | Fuels | Neoprene, Nitrile, or Natural Rubber | Y | Y | More Info | Y | More Info | Y | Y | Ok (for all) |
| Group 11 | Lubricants/Oils | Oil-Proof Neoprene or Rubber | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 12 | Hydraulic Fluids | Neoprene for Petroleum-Based Fluids<br>Butyl Rubber for Synthetic, Fire Resistant Fluids | More Info | OK (Petroleum-Based Fluids) | OK (Fire-resistant Fluids) | N | More Info | More Info | More Info | Ok (for all) |
| Group 13 | Greases | Protective Gloves | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
| Group 14 | Polish/Wax Compounds | Protective Gloves | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
| Group 15 | Corrosion Preventive Compounds | Rubber | More Info | More Info | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 16 | Antifreeze | Chemical Resistant Neoprene, Natural Latex, or Butyl Rubber | More Info | Y | Y | N | Y | More Info | More Info | Ok (for all) |
| Group 17 | Compressed Gases | None | Consult MSDS for proper PPE, if applicable | | | | | | | |
| Group 18 | Oxidizers | Neoprene | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 19 | Fluorescent Lamps | Protective Gloves | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
| Group 20 | Heavy Metals | Protective Gloves | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |

*Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing the appropriate protective gloves. Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.*

*Glove is recommended by NSTM 670 (Vol. 2) HMUG*

*Glove is acceptable under certain conditions listed in the block*

*Glove is not recommended for protection against chemicals in this group*

*Additional information on proper glove selection is available*

Back to the "How to Use This Matrix" Page

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| Group 2 | Alkalies/Bases/Caustics | Rubber | More Info | More Info | Y | Y | Y | More Info | More Info | Ok (for all) |
| Group 3 | Detergents/Soaps | Rubber | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
| Group 4 | Photographic Chemicals | Rubber | More Info | More Info | Y | Y | Y | More Info | More Info | Ok (for all) |
| Group 5 | Adhesives | Neoprene or Rubber | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 6 | Cleaning Compounds | Rubber | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
| Group 7 | Aerosols | Neoprene | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 8 | Paint Materials (Oil-Based) | Neoprene for Oil-Based Paints<br>Any Protective Glove for Water-Based | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 9 | Solvents | Solvent-Resistant | More Info | More Info | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 10 | Fuels | Neoprene, Nitrile, or Natural Rubber | Y | Y | More Info | Y | More Info | Y | Y | Ok (for all) |
| Group 11 | Lubricants/Oils | Oil-Proof Neoprene or Rubber | More Info | Y | More Info | N | More Info | More Info | More Info | Ok (for all) |
| Group 12 | Hydraulic Fluids | Neoprene for Petroleum-Based Fluids<br>Butyl Rubber for Synthetic, Fire Resistant Fluids | More Info | OK (Petroleum-Based Fluids) | OK (Fire-resistant Fluids) | N | More Info | More Info | More Info | Ok (for all) |
| Group 13 | Greases | Protective Gloves | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
| Group 14 | Polish/Wax Compounds | Protective Gloves | Y | Y | Y | Y | Y | Y | Y | Ok (for all) |
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Back to the "How to Use This Matrix" Page

| Chemical | Chemical Protection Offered by Various Glove Materials* | | | | |
|---|---|---|---|---|---|
| | Neoprene | Natural Latex/Rubber | Butyl | Nitrile | Multi-Layer Laminate |
| Acetaldehyde | Very Good | Good | Very Good | Good | Excellent |
| Acetic Acid | Very Good | Good | Very Good | Good | Excellent |
| Acetone | Good | Very Good | Very Good | Poor | Excellent |
| Ammonium Hydroxide | Very Good | Very Good | Very Good | Very Good | Excellent |
| Amyl Acetate | Fair | Poor | Fair | Poor | Not Tested |
| Aniline | Good | Fair | Fair | Poor | Excellent |
| Benzaldehyde | Fair | Fair | Good | Good | Insufficient Data |
| Benzene | Poor | Poor | Poor | Fair | Excellent |
| Butyl Acetate | Good | Fair | Fair | Poor | Excellent |
| Butyl Alcohol | Very Good | Very Good | Very Good | Very Good | Excellent |
| Carbon Disulfide | Fair | Fair | Fair | Fair | Excellent |
| Carbon Tetrachloride | Fair | Poor | Poor | Good | Excellent |
| Castor Oil | Fair | Poor | Fair | Very Good | Not Tested |
| Chlorobenzene | Fair | Poor | Fair | Poor | Excellent |
| Chloroform | Good | Poor | Poor | Fair | Excellent |
| Chloronapthalene | Fair | Poor | Fair | Fair | Excellent |
| Chromic Acid (50% strength) | Fair | Poor | Fair | Fair | Excellent |
| Citric Acid (10% strength) | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Cyclohexanol | Good | Fair | Good | Very Good | Excellent |
| Dibutyle Pthalate | Good | Poor | Good | Good | Excellent |
| Diesel Fuel | Good | Poor | Poor | Very Good | Not Tested |
| Diisobutyle Ketone | Poor | Fair | Good | Poor | Excellent |
| Dimethylformamide | Fair | Fair | Good | Good | Excellent |
| Dioctyl Pthalate | Good | Poor | Fair | Very Good | Insufficient Data |
| Dioxane | Very Good | Good | Good | Good | Excellent |
| Epoxy resins, dry | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Ethyl acetate | Good | Fair | Good | Fair | Excellent |
| Ethyl alcohol | Very Good | Very Good | Very Good | Very Good | Excellent |
| Ethyl ether | Very Good | Good | Very Good | Good | Excellent |
| Ethylene dichloride | Fair | Poor | Fair | Poor | Excellent |
| Ethylene glycol | Very Good | Very Good | Very Good | Very Good | Excellent |
| Formaldehyde | Very Good | Very Good | Very Good | Very Good | Excellent |
| Formic acid | Very Good | Very Good | Very Good | Very Good | Very Good |
| Freon 11 | Good | Poor | Fair | Good | Not Tested |
| Freon 12 | Good | Poor | Fair | Good | Not Tested |

# Hand Protection General Selection Procedure

- Identify the hazard(s) of the material you will be working with
  - Review references (MRC, MSDS/SDS, etc.)
- Determine if you will have “incidental” or “extended” contact
  - “Incidental”
    - A few splashes or minimal contact
    - Gloves removed soon after exposure
  - “Extended”
    - Immersion in liquid or many splashes
    - Chemical remains on gloves for a long period of time

# Hand Protection General Selection Procedure

- Incidental contact
  - Thin, disposable nitrile gloves provide adequate protection against some chemicals
  - Recommend changing glove if it gets contaminated with chemical
  - Cross-check with the Chemical Protective Glove matrix
- Extended contact
  - Thicker gloves of the appropriate material are generally required
  - Cross-check Chemical Protective Glove matrix

# Chemical Protective Gloves

- Manufacturers test gloves to determine which provide best protection against specific chemicals

- Testing includes factors such as:
  - How long chemical takes to “break through” glove
  - Damage to glove material caused by the chemical
  - How quickly the chemical permeates through glove

- When in doubt about which glove to use:
  - Recommend use of a nitrile or neoprene glove
  - Multi-layer gloves also provide excellent protection from most chemicals but can be punctured/torn easily and can feel awkward unless used with a thin, nitrile glove on top

# *Verify Proper Glove Selection*

- Proper chemical protective glove selection should always be verified* by
  - Work Center Supervisors
  - Command Safety Officers and/or the Hazardous Materials Coordinator

*See OPNAVINST 5100.19E, paragraph B1203(c)(3)

# *Let's Run Through a Few Scenarios*

# *Example #1- Corrosion Prevention*

- Suppose a maintenance task requires the use of Corrosion Preventive Compound (SPIN #00322)
- Maintenance task involves brushing corrosion prevention compound on parts
- Suppose the risk of hand exposure is low (incidental splash potential)
- Which glove provides the appropriate protection?

# *Example #1- Corrosion Prevention*

- Step #1: Determine specific composition of the corrosion prevention compound
  - MSDS/SDS indicates aliphatic mineral spirits (petroleum distillates) and several chlorofluorocarbon (CFC) propellants
- Step #2: Assess the potential exposure risk
  - Maintenance task involves no immersion of hands in material, but there is some risk of incidental splashes

# *Example #1- Corrosion Prevention*

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Corrosion Preventive Compounds = HMUG Group #15
    - HMUG Group #15 recommends “Rubber Gloves”
      - This is vague… there are several different types of rubber
  - Cross-check glove recommendation in product MSDS/SDS
    - MSDS/SDS recommends “Oil Impervious” (also vague!) gloves

# Example #1- Corrosion Prevention

- Step #3 (cont'd): Cross-check aliphatic mineral spirits (petroleum distillates) against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #15
  - Scroll down to "Petroleum Distillates"
  - Select appropriate glove type
    - Multi-layer laminate- Excellent
    - Nitrile- Very Good
    - Neoprene- Good
    - Natural latex- Not Recommended
    - Butyl Rubber- Not Recommended

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| Group 12 | Hydraulic Fluids | Neoprene for Petroleum-Based Fluids<br>Butyl Rubber for Synthetic, Fire Resistant Fluids | More Info | OK (Petroleum-Based Fluids) | OK (Fire-resistant Fluids) | N | More Info | More Info | More Info |
| Group 13 | Greases | Protective Gloves | T | T | T | T | T | T | T |
| Group 14 | Polish/Wax Compounds | Protective Gloves | T | T | T | T | T | T | T |
| Group 15 | Corrosion Preventive Compounds | Rubber | More Info | More Info | More Info | N | More Info | More Info | More Info |
| Group 16 | Antifreeze | Chemical Resistant Neoprene, Natural Latex, or Butyl | More Info | T | T | N | T | More Info | More Info |
| Group 17 | Compressed Gases | None | Consult MSDS for proper PPE, if applicable | | | | | | |
| Group 18 | Oxidizers | Neoprene | More Info | T | More Info | N | More Info | More Info | More Info |
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|---|---|---|---|---|---|
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| Kerosene | Very Good | Fair | Fair | Very Good | Excellent |
| Ketones | Good | Very Good | Very Good | Poor | Excellent |
| Lacquer thinners | Good | Fair | Fair | Poor | Excellent |
| Lactic acid (85%) | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Lauric acid (36%) | Very Good | Fair | Very Good | Very Good | Not Tested |
| Lineolic acid | Very Good | Poor | Fair | Good | Not Tested |
| Linseed oil | Very Good | Poor | Fair | Very Good | Not Tested |
| Maleic acid | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Methyl alcohol | Very Good | Very Good | Very Good | Very Good | Excellent |
| Methylamine | Fair | Fair | Good | Good | Fair |
| Methyl bromide | Good | Fair | Good | Fair | Not Tested |
| Methyl chloride | Poor | Poor | Poor | Poor | Excellent |
| Methyl ethyl ketone | Good | Good | Very Good | Poor | Excellent |
| Methyl isobutyl ketone | Fair | Fair | Very Good | Poor | Excellent |
| Methyl methacrylate | Good | Good | Very Good | Fair | Excellent |
| Monoethanolamine | Very Good | Good | Very Good | Very Good | Not Tested |
| Morpholine | Very Good | Very Good | Very Good | Good | Excellent |
| Naphthalene | Good | Fair | Fair | Good | Excellent |
| Napthas, aliphatic | Very Good | Fair | Fair | Very Good | Excellent |
| Napthas, aromatic | Good | Poor | Poor | Good | Excellent |
| Nitric acid | Good | Fair | Fair | Fair | Excellent |
| Nitric acid, red and white fuming | Poor | Poor | Poor | Poor | Very Good |
| Nitromethane (95.5%) | Fair | Poor | Fair | Fair | Excellent |
| Nitropropane (95.5%) | Fair | Poor | Fair | Fair | Excellent |
| Octyl alcohol | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Oleic acid | Very Good | Fair | Good | Very Good | Not Tested |
| Oxalic acid | Very Good | Very Good | Very Good | Very Good | Excellent |
| Palmitic acid | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Perchloric acid (60%) | Very Good | Fair | Good | Good | Excellent |
| Perchloroethylene | Fair | Poor | Poor | Good | Excellent |
| Petroleum distillates (Napthas/mineral spirits | Good | Poor | Poor | Very Good | Excellent |
| Phenol | Very Good | Fair | Good | Fair | Excellent |
| Phosphoric acid | Very Good | Good | Very Good | Very Good | Excellent |
| Potassium hydroxide | Very Good | Very Good | Very Good | Very Good | Excellent |
| Propyl acetate | Good | Fair | Good | Fair | Excellent |

Page 1

# Example #1- Corrosion Prevention

- Step #4: Worker Performance and Comfort
  - Suppose this maintenance involves manipulating small screws and other parts, so a relatively high level of dexterity is needed

- Results
  - At the time of this writing, Multi-Layer Laminate gloves are relatively uncommon though they are very protective
    - However, they would be overkill since the task has a low exposure risk (incidental splash)
  - Nitrile is a good choice
    - Due to low exposure risk, thin (4 mil or 8 mil), disposable nitrile gloves are a good choice

# *Example #1- Corrosion Prevention*

The final Step is for Work Center Supervisor and Safety Officer or Hazardous Materials Coordinator to verify that thin, disposable nitrile gloves are the appropriate alternative to the chemical protective gloves required by the MRC

# *Example #2- Toluene*

- Suppose an MRC requires the use of Toluene, Technical Grade (SPIN #01391)
- Suppose this maintenance task involves high risk of contact with toluene (immersion)
- Which glove provides the appropriate protection?

# Example #2- Toluene

- Step #1: Determine specific composition of compound
  - MSDS indicates that toluene (an aromatic hydrocarbon) is the only component of product
- Step #2: Assess the Potential Exposure Risk
  - Suppose maintenance task involves partial immersion of hands in material

| NSTM 670 (Vol. 2) HMUG Chemical Group # | NSTM 670 (Vol. 2) HMUG Chemical Group Name | NSTM 670 (Vol. 2) HMUG Hand Protection (Chemical) Recommendation (See Note 1 below) | Chemical Resistant Glove Type | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Nitrile (Green "OTTO Fuel") Gauntlet Gloves | Neoprene Gloves | Butyl (Synthetic) Rubber "Toxicological Agents Protective" Gloves | PVC Coated Rubber (Chemical/Oil Protective) Gloves | Black Natural Latex Rubber "Industrial" Gloves | 8-mil Disposable Nitrile Gloves | 4-mil Disposable Nitrile Gloves |
| | | | SPIN: 02006 | SPIN: TBD | SPIN: 02005 | SPIN: 00517 | SPIN: 00525 | SPIN: 02026 (8 mil thick) | SPIN: 1793 (4 mil thick |
| Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs. | | | | | | | | NOTE: Incidental (Splash) contact only. Replace with new glove if contamination | |
| Group 1 | Acids | Acid-Resistant | More Info | More Info | More Info | N | More Info | More Info | More Info |
| Group 2 | Alkalies/Bases/Caustics | Rubber | More Info | More Info | Y | Y | Y | More Info | More Info |
| Group 3 | Detergents/Soaps | Rubber | Y | Y | Y | Y | Y | Y | Y |
| Group 4 | Photographic Chemicals | Rubber | More Info | More Info | Y | Y | Y | More Info | More Info |
| Group 5 | Adhesives | Neoprene or Rubber | More Info | Y | More Info | N | More Info | More Info | More Info |
| Group 6 | Cleaning Compounds | Rubber | Y | Y | Y | Y | Y | Y | Y |
| Group 7 | Aerosols | Neoprene | More Info | Y | More Info | N | More Info | More Info | More Info |
| Group 8 | Paint Materials (Oil-Based) | Neoprene for Oil-Based Paints<br>Any Protective Glove for Water-Based | More Info | Y | More Info | N | More Info | More Info | More Info |
| Group 9 | Solvents | Solvent-Resistant | More Info | More Info | More Info | N | More Info | More Info | More Info |
| Group 10 | Fuels | Neoprene, Nitrile, or Natural Rubber | Y | Y | More Info | Y | More Info | Y | Y |
| Group 11 | Lubricants/Oils | Oil-Proof Neoprene or Rubber | More Info | Y | More Info | N | More Info | More Info | More Info |
| Group 12 | Hydraulic Fluids | Neoprene for Petroleum-Based Fluids<br>Butyl Rubber for Synthetic, Fire Resistant Fluids | More Info | OK (Petroleum-Based Fluids) | OK (Fire-resistant Fluids) | N | More Info | More Info | More Info |
| Group 13 | Greases | Protective Gloves | Y | Y | Y | Y | Y | Y | Y |
| Group 14 | Polish/Wax Compounds | Protective Gloves | Y | Y | Y | Y | Y | Y | Y |
| Group 15 | Corrosion Preventive Compounds | Rubber | More Info | More Info | More Info | N | More Info | More Info | More Info |
| Group 16 | Antifreeze | Chemical Resistant Neoprene, Natural Latex, or Butyl | More Info | Y | Y | N | Y | More Info | More Info |
| Group 17 | Compressed Gases | None | Consult MSDS for proper PPE, if applicable | | | | | | |
| Group 18 | Oxidizers | Neoprene | More Info | Y | More Info | N | More Info | More Info | More Info |
| Group 19 | Fluorescent Lamps | Protective Gloves | Y | Y | Y | Y | Y | Y | Y |
| Group 20 | Heavy Metals | Protective Gloves | Y | Y | Y | Y | Y | Y | Y |

*Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing th*

*Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.*

*Glove is recommended by NSTM 670 (Vol. 2) HMUG*

*Glove is acceptable under certain conditions listed in the block*

*Glove is not recommended for protection against chemicals in this group*

Back to the "How to Use This Matrix" Page

# Example #2- Toluene

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Toluene is a Solvent = HMUG Group #9
    - HMUG Group #9 recommends “Solvent-Resistant” Gloves
      - Again, very vague… which glove is best depends on which solvent is used
  - Cross-check glove recommendation in product  MSDS
    - MSDS/SDS  recommends “Use Gloves” (vague!)
- Neither of these recommendations is very specific… we need to keep investigating

# Example #2- Toluene

- Step #3 (cont'd): Cross-check Toluene against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #9
  - Scroll down to "Toluene"
  - Select appropriate glove type
    - Multi-layer laminate- Excellent
    - Nitrile- Fair
    - Neoprene- Fair
    - Natural latex- Not Recommended
    - Butyl Rubber- Not Recommended

| Chemical | Chemical Protection Offered by Various Glove Materials* | | | | |
|---|---|---|---|---|---|
| | Neoprene | Natural Latex/Rubber | Butyl | Nitrile | Multi-Layer Laminate** |
| Monoethanolamine | Very Good | Good | Very Good | Very Good | Not Tested |
| Morpholine | Very Good | Very Good | Very Good | Good | Excellent |
| Naphthalene | Good | Fair | Fair | Good | Excellent |
| Napthas, aliphatic | Very Good | Fair | Fair | Very Good | Excellent |
| Napthas, aromatic | Good | Poor | Poor | Good | Excellent |
| Nitric acid | Good | Fair | Fair | Fair | Excellent |
| Nitric acid, red and white fuming | Poor | Poor | Poor | Poor | Very Good |
| Nitromethane (95.5%) | Fair | Poor | Fair | Fair | Excellent |
| Nitropropane (95.5%) | Fair | Poor | Fair | Fair | Excellent |
| Octyl alcohol | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Oleic acid | Very Good | Fair | Good | Very Good | Not Tested |
| Oxalic acid | Very Good | Very Good | Very Good | Very Good | Excellent |
| Palmitic acid | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Perchloric acid (60%) | Very Good | Fair | Good | Good | Excellent |
| Perchloroethylene | Fair | Poor | Poor | Good | Excellent |
| Petroleum distillates (Napthas/mineral spirits | Good | Poor | Poor | Very Good | Excellent |
| Phenol | Very Good | Fair | Good | Fair | Excellent |
| Phosphoric acid | Very Good | Good | Very Good | Very Good | Excellent |
| Potassium hydroxide | Very Good | Very Good | Very Good | Very Good | Excellent |
| Propyl acetate | Good | Fair | Good | Fair | Excellent |
| Propyl alcohol | Very Good | Very Good | Very Good | Very Good | Excellent |
| Propyl alcohol (iso) | Very Good | Very Good | Very Good | Very Good | Excellent |
| Sodium hydroxide | Very Good | Very Good | Very Good | Very Good | Excellent |
| Styrene | Poor | Poor | Poor | Fair | Excellent |
| Styrene (100%) | Poor | Poor | Poor | Fair | Excellent |
| Sulfuric acid | Good | Good | Good | Good | Excellent |
| Tannic acid (65%) | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Tetrahydrofuran | Poor | Fair | Fair | Fair | Excellent |
| Toluene | Fair | Poor | Poor | Fair | Excellent |
| Toluene diisocyanate (TDI) | Fair | Good | Good | Fair | Excellent |
| Trichloroethylene | Fair | Fair | Poor | Good | Excellent |
| Triethanolamine (85%) | Very Good | Good | Good | Very Good | Excellent |
| Tung oil | Very Good | Poor | Fair | Very Good | Not Tested |
| Turpentine | Good | Fair | Fair | Very Good | Not Tested |
| Xylene | Poor | Poor | Poor | Fair | Excellent |

# Example #2- Toluene

- Step #4: Worker Performance and Comfort
  - Suppose this maintenance task doesn't involve small screws or other parts so a high degree of dexterity is not required
- Results
  - Multi-layer laminate, nitrile, and neoprene are options in this example
  - Again, at the time of this writing, Multi-Layer Laminate gloves are relatively uncommon though they are very protective in tasks with high risk of chemical contact and so would make a good choice for this task, if available
  - Nitrile and neoprene are also options since they provide fair protection.
    - However, since the task involves a high risk of contact with the chemical, it's best to select a thicker version of the glove (13 mil) rather than a thinner version (such as the thin (4 or 8 mil) disposable nitrile) as in the last example

# Example #2- Toluene

The final Step is for Work Center Supervisor and Safety Officer or Hazardous Materials Coordinator to verify that thicker nitrile gloves (13 mil green Otto Fuel gloves, for example) are the appropriate alternative to the chemical protective gloves required by the MRC

# *Example #3: Multiple Components*

- What if we have a chemical product with several different chemical components?

- For example, suppose a paint is comprised of paint solids dissolved in a mixture of solvents?

# *Example #3- Multiple Components*

- Step #1: Determine specific composition of compound
  - MSDS indicates that the paint solids are dissolved in a mixture of n-butyl alcohol, xylene, and toluene solvents
- Step #2: Assess Exposure Risk
  - Maintenance task involves brush/roller application with only an incidental splash exposure hazard

# *Example #3- Multiple Components*

- Step #3: Worker Performance and Comfort
  - Brush and roller painting doesn't require a high degree of dexterity
  - However, the exposure risk is low so there's no need to burden the maintenance person with an overly thick glove

# *Example #3- Multiple Components*

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Haze Gray paint is a “Paint Material”= HMUG Group #8
  - Cross-check glove recommendation in product MSDS
    - Suppose the MSDS recommends use of “Protective Gloves”

# *Example #3- Multiple Components*

- Step #3, cont'd: Cross-check n-butyl alcohol, xylene, and toluene against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #8
  - Scroll down to appropriate rows
    - There is no "n-butyl alcohol" listed!
    - But a Google search indicates that a synonym for n-butyl alcohol is "Butyl alcohol" (which is listed)

| NSTM 670 (Vol. 2) HMUG Chemical Group # | NSTM 670 (Vol. 2) HMUG Chemical Group Name | NSTM 670 (Vol. 2) HMUG Hand Protection (Chemical) Recommendation (See Note 1 below) | Chemical Resistant Glove Type | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Nitrile (Green "OTTO Fuel") Gauntlet Gloves | Neoprene Gloves | Butyl (Synthetic) Rubber "Toxicological Agents Protective" Gloves | PVC Coated Rubber (Chemical/Oil Protective) Gloves | Black Natural Latex Rubber "Industrial" Gloves | 8-mil Disposable Nitrile Gloves | 4-mil Disposable Nitrile Gloves |
| | | | SPIN: 02086 | SPIN: TBD | SPIN: 02085 | SPIN: 00517 | SPIN: 00525 | SPIN: 02826 (8 mil thick) | SPIN: 1793 (4 mil thick |
| Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs. | | | | | | | | NOTE: Incidental (Splash) contact only. Replace with new glove if contamination | |
| Group 1 | Acids | Acid-Resistant | More Info | More Info | More Info | N | More Info | More Info | More Info |
| Group 2 | Alkalies/Bases/Caustics | Rubber | More Info | More Info | T | T | T | More Info | More Info |
| Group 3 | Detergents/Soaps | Rubber | T | T | T | T | T | T | T |
| Group 4 | Photographic Chemicals | Rubber | More Info | More Info | T | T | T | More Info | More Info |
| Group 5 | Adhesives | Neoprene or Rubber | More Info | T | More Info | N | More Info | More Info | More Info |
| Group 6 | Cleaning Compounds | Rubber | T | T | T | T | T | T | T |
| Group 7 | Aerosols | Neoprene | More Info | T | More Info | N | More Info | More Info | More Info |
| Group 8 | Paint Materials (Oil-Based) | Neoprene for Oil-Based Paints<br>Any Protective Glove for Water-Based | More Info | T | More Info | N | More Info | More Info | More Info |
| Group 9 | Solvents | Solvent-Resistant | More Info | More Info | More Info | N | More Info | More Info | More Info |
| Group 10 | Fuels | Neoprene, Nitrile, or Natural Rubber | T | T | More Info | T | More Info | T | T |
| Group 11 | Lubricants/Oils | Oil-Proof Neoprene or Rubber | More Info | T | More Info | N | More Info | More Info | More Info |
| Group 12 | Hydraulic Fluids | Neoprene for Petroleum-Based Fluids<br>Butyl Rubber for Synthetic, Fire Resistant Fluids | More Info | OK (Petroleum-Based Fluids) | OK (Fire-resistant Fluids) | N | More Info | More Info | More Info |
| Group 13 | Greases | Protective Gloves | T | T | T | T | T | T | T |
| Group 14 | Polish/Wax Compounds | Protective Gloves | T | T | T | T | T | T | T |
| Group 15 | Corrosion Preventive Compounds | Rubber | More Info | More Info | More Info | N | More Info | More Info | More Info |
| Group 16 | Antifreeze | Chemical Resistant Neoprene, Natural Latex, or Butyl | More Info | T | T | N | T | More Info | More Info |
| Group 17 | Compressed Gases | None | Consult MSDS for proper PPE, if applicable | | | | | | |
| Group 18 | Oxidizers | Neoprene | More Info | T | More Info | N | More Info | More Info | More Info |
| Group 19 | Fluorescent Lamps | Protective Gloves | T | T | T | T | T | T | T |
| Group 20 | Heavy Metals | Protective Gloves | T | T | T | T | T | T | T |

*Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing th*

*Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.*

*Glove is recommended by NSTM 670 (Vol. 2) HMUG*

*Glove is acceptable under certain conditions listed in the block*

*Glove is not recommended for protection against chemicals in this group*

Back to the "How to Use This Matrix" Page

| Chemical | Chemical Protection Offered by Various Glove Materials* | | | | |
|---|---|---|---|---|---|
| | Neoprene | Natural Latex/Rubber | Butyl | Nitrile | Multi-Layer Laminate** |
| Nitromethane (95.5%) | Fair | Poor | Fair | Fair | Excellent |
| Nitropropane (95.5%) | Fair | Poor | Fair | Fair | Excellent |
| Octyl alcohol | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Oleic acid | Very Good | Fair | Good | Very Good | Not Tested |
| Oxalic acid | Very Good | Very Good | Very Good | Very Good | Excellent |
| Palmitic acid | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Perchloric acid (60%) | Very Good | Fair | Good | Good | Excellent |
| Perchloroethylene | Fair | Poor | Poor | Good | Excellent |
| Petroleum distillates (Napthas/mineral spirits | Good | Poor | Poor | Very Good | Excellent |
| Phenol | Very Good | Fair | Good | Fair | Excellent |
| Phosphoric acid | Very Good | Good | Very Good | Very Good | Excellent |
| Potassium hydroxide | Very Good | Very Good | Very Good | Very Good | Excellent |
| Propyl acetate | Good | Fair | Good | Fair | Excellent |
| Propyl alcohol | Very Good | Very Good | Very Good | Very Good | Excellent |
| Propyl alcohol (iso) | Very Good | Very Good | Very Good | Very Good | Excellent |
| Sodium hydroxide | Very Good | Very Good | Very Good | Very Good | Excellent |
| Styrene | Poor | Poor | Poor | Fair | Excellent |
| Styrene (100%) | Poor | Poor | Poor | Fair | Excellent |
| Sulfuric acid | Good | Good | Good | Good | Excellent |
| Tannic acid (65%) | Very Good | Very Good | Very Good | Very Good | Not Tested |
| Tetrahydrofuran | Poor | Fair | Fair | Fair | Excellent |
| Toluene | Fair | Poor | Poor | Fair | Excellent |
| Toluene diisocyanate (TDI) | Fair | Good | Good | Fair | Excellent |
| Trichloroethylene | Fair | Fair | Poor | Good | Excellent |
| Triethanolamine (85%) | Very Good | Good | Good | Very Good | Excellent |
| Tung oil | Very Good | Poor | Fair | Very Good | Not Tested |
| Turpentine | Good | Fair | Fair | Very Good | Not Tested |
| Xylene | Poor | Poor | Poor | Fair | Excellent |
| Butyl Alcohol | Very Good | Very Good | Very Good | Very Good | Excellent |

# *Example #3: Multiple Components*

| | Chemical Protection by Glove Type | | | | |
|---|---|---|---|---|---|
| **Solvent Component** | **Nitrile** | **Neoprene** | **Natural Latex Rubber** | **Butyl Rubber** | **Multi-layer Laminate** |
| n-butyl alcohol | Very Good | Very Good | Very Good | Very Good | Excellent |
| Xylene | Fair | Poor | Poor | Poor | Excellent |
| Toluene | Fair | Fair | Poor | Poor | Excellent |

# Example #3- Multiple Components

- Results
  - The table in this example shows:
    - Multi-layer laminate provides the best protection against the three solvents.
    - All gloves provide good protection from n-butyl alcohol
    - Neoprene, butyl rubber, and natural latex rubber provide poor protection from at least one solvent in the mixture
    - Nitrile provides Fair to Very Good protection against all of the solvents
  - Nitrile and the Multi-Layer Laminate provide the best protection
    - The Multi-Layer Laminate is relatively uncomfortable and is overkill for the application since the likely exposure hazard is low
    - Nitrile is probably the best option.
      - For this application (where only minimal contact is likely), a thin (4 or 8 mil) disposable nitrile would be appropriate

# *Example #3- Multiple Components*

The final Step is for Work Center Supervisor and Safety Officer or Hazardous Materials Coordinator to verify that the thin, disposable nitrile gloves are an appropriate alternative to the chemical protective gloves required by the MRC

# *What if…*

- What if neither the HMUG, MSDS, or Chemical Protective Glove matrix gives good guidance on the best glove?

- Support Structure
  - Command Safety Officer
  - Command Hazardous Materials Coordinator
  - Supporting Industrial Hygiene office
  - Chemical protective glove manufacturers

# What Else is Important to Know?

- Proper glove maintenance!
  - Gloves don't last forever!
- Damage to gloves can and DOES occur and can affect the
  - Permeation
  - Degradation
- Always "pre-flight" the gloves to check for damage before wearing
- Always wash your hands after glove use

# Checking Gloves Before Use

- Check for holes
  - Step 1: Hold the glove by the cuff and “flip” it several times to trap air inside
  - Step 2: Hold the glove near your face while gently squeezing the glove. If you feel air hitting your face the glove may have a hole and could need replacing
  - Step 3: If no air is felt then glove likely does not have a hole. Move to next slide.

# Check for Glove Damage

- Dispose of gloves if you see
  - Discolored areas
  - Sticky, gummy areas
  - Fingers sticking together
  - Pinholes,  tears, or blisters in the glove material
  - Areas where the glove texture has changed or rubbed off
  - Cracks where glove was folded over itself
  - Areas where chemicals, oils/grease have dried onto the glove

# *Chemical Protective Glove Types*

# Nitrile "Otto Fuel" Gloves

- "Nitrile" is a type of synthetic rubber
- Provides good protection against solvents, oils, hydraulic fluids, dilute acids/bases
- Also known as "Gloves, Chemical and Oil Resistant, Disposable"
- A common glove recommended for onboard maintenance
- Gloves should be discarded if exposed to OTTO fuel

# *Nitrile “OTTO Fuel” Chemical Resistant Gloves*

# Neoprene

- Neoprene is another type of synthetic rubber
- Provides wide range of protection against chemicals in several groups
  - Organic solvents
  - Oils
  - Peroxides
  - Fuels
  - Hydrocarbons
  - Alcohols
  - Acid/bases

# Neoprene Chemical Resistant Gloves

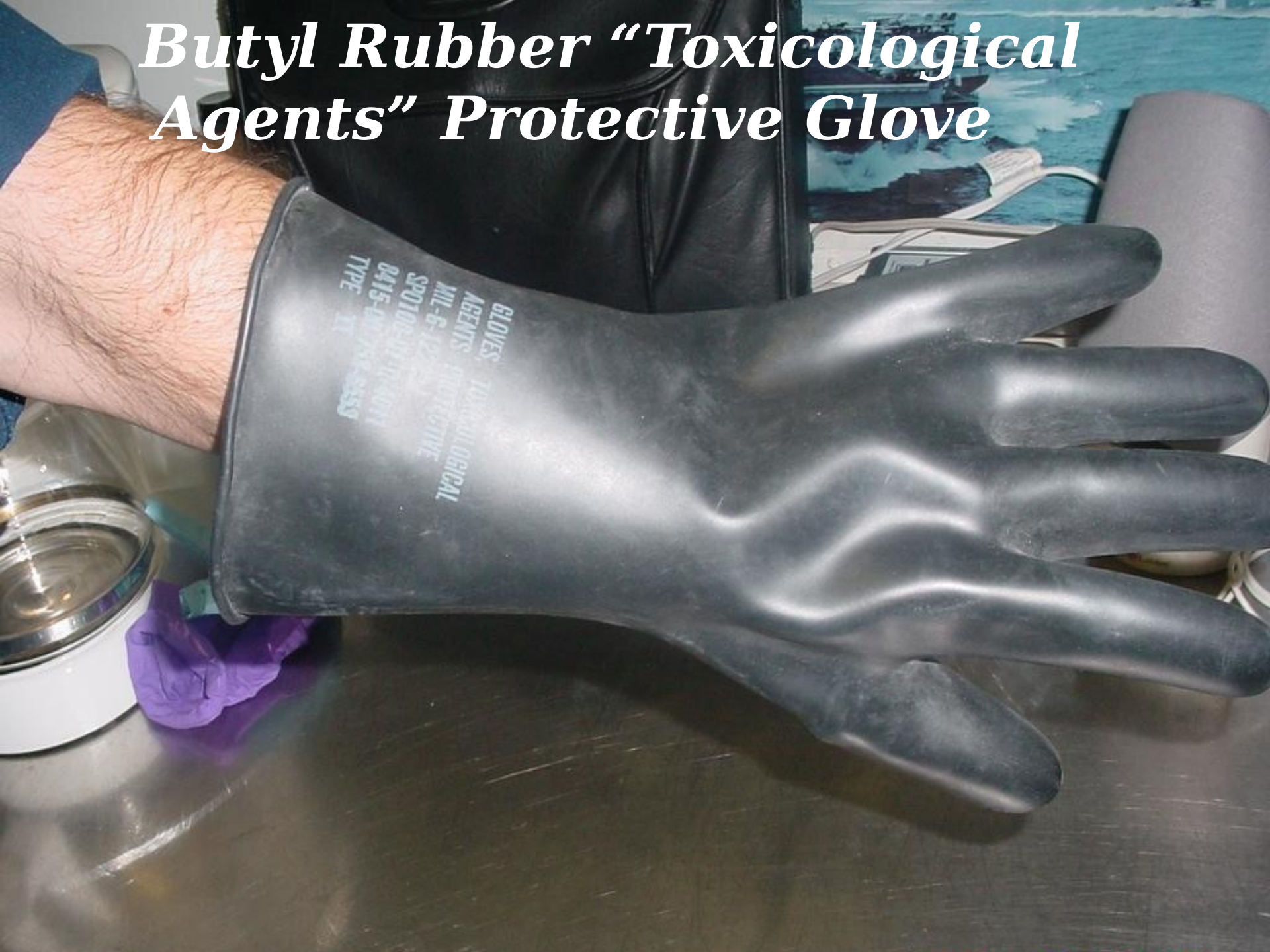
***These are stock photos of neoprene gloves from various manufacturers.***

***Display does not constitute endorsement of a particular product.***

# Butyl Rubber

- Butyl rubber is another type of synthetic rubber
- Good chemical resistance against many chemicals
  - Very good against acids/bases
  - Good protection against some solvents
- Generally offers relatively poor dexterity

# *Butyl Rubber "Toxicological Agents" Protective Glove*



# Polyvinyl Chloride-Coated Natural Latex Rubber

- Natural latex rubber gloves with PVC coating
- Provide resistance against some chemical groups
  - PVC is not generally good against solvents
- Have a cotton inner lining
- Limited dexterity

# *PVC-Coated Natural Rubber Gloves*

# *Natural Latex Rubber*

- Black colored “Industrial” Gloves
  - Gauntlet length (about 14” long)
  - Somewhat similar in appearance to electrical safety gloves
    - ***Don’t get them mixed up!!***
    - ***These are <u>not</u> designed to provide electrical protection!!***

# Natural Latex Rubber

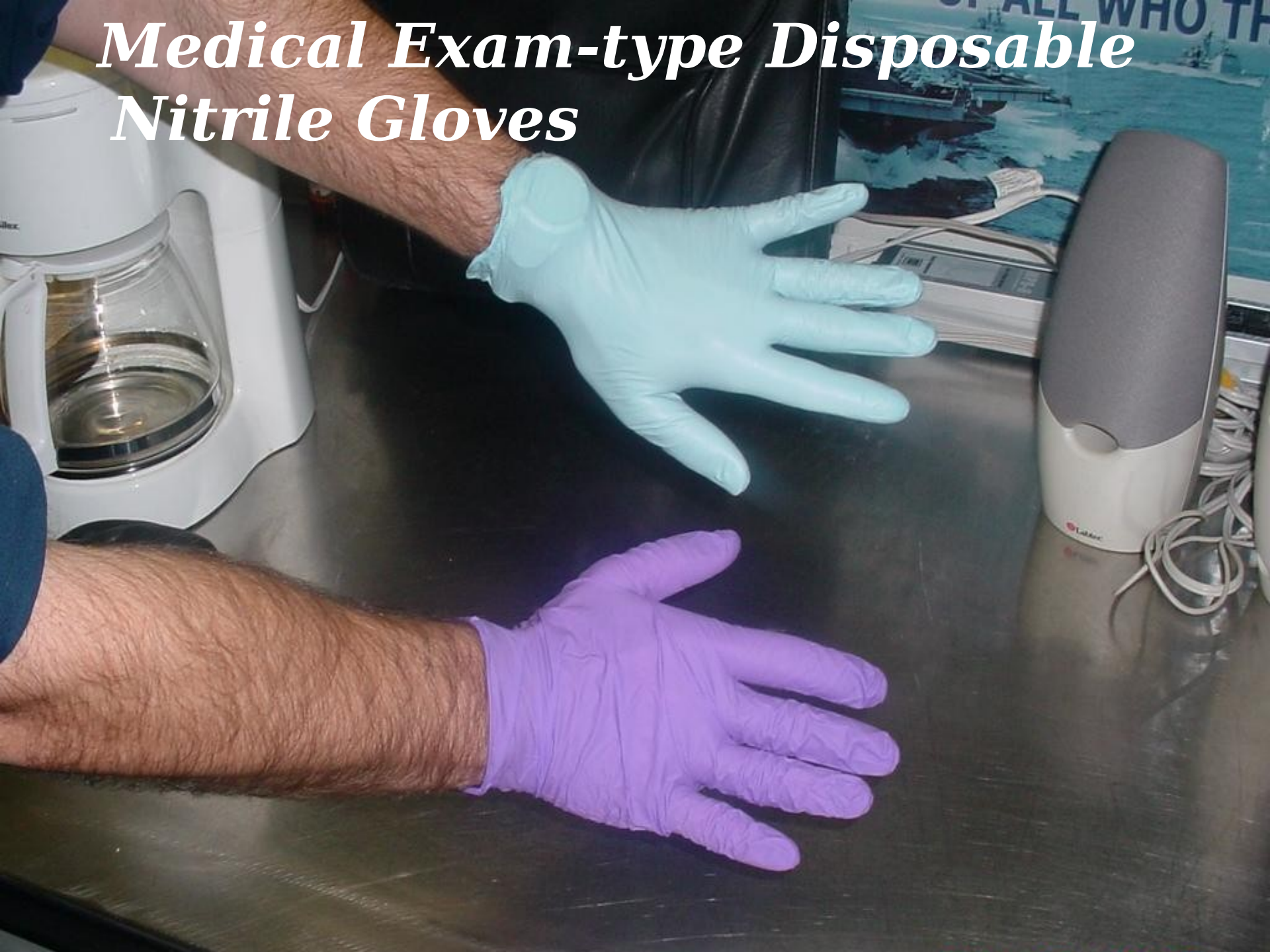
- Provides protection against some acids and bases (acids/bases). For example:
  - Cleaning compounds
- Natural latex rubber does not provide good protection against most solvents or oil-based chemicals
  - Doesn't protection well against hydraulic fluid, paint solvent, gasoline, kerosene, most cleaning solvents (Acetone is an exception)

# Natural Latex Rubber “Industrial” Glove

# Disposable Nitrile

- Similar to latex medical glove, but made from nitrile
  - Popular because of cost and allows good dexterity
  - Provides chemical resistance for various chemicals
    - Not good for heavy exposure or immersion in chemical
  - Can be used as an under-layer or over-layer for other gloves

# *Medical Exam-type Disposable Nitrile Gloves*



# Multi-Layer Laminate Gloves

- Provides highest level of protection to more chemicals than any other glove type
- Very thin (2.7 mil), allows good dexterity
- Feels “strange” at first due to laminate construction, but a thin, nitrile outer glove helps the laminate material better conform to the hand

# Multi-Layer Laminate Gloves

***Gloves that should NOT be used for protection against industrial chemicals***

# Non-Nitrile Disposable Gloves

- Surgical Latex (medical exam gloves)
  - Do NOT provide any chemical resistance
  - Will dissolve in oil-based solvents
  - ONLY to be used for medical purposes
- Vinyl (food processor gloves)
  - Also provide little chemical resistance
  - Designed for hygiene during food processing

Surgical Latex and Food Processor Vinyl Gloves
Do not use for chemical protection!!

# *Chemical, Biological, and Radiological (CBR) Gloves*

- Made from thick Butyl Rubber
  - Provides resistance to a wide variety of chemical and biological warfare agents
  - Designed for use with MOPP gear
- Similar to “Toxicological Agents” glove
- CBR Gloves come in a Set
  - Two Butyl rubber overgloves
  - Two cotton undergloves
- Very expensive, don’t use for daily maintenance

# *CBR Butyl Rubber "Glove Set"*

# Proper Glove Storage

- Do not store gloves that have chemical residue on them
- Do not store gloves in a folded position
- Do not store PPE in HAZMAT locker due to potential chemical contamination and degradation of protective material
- Ensure all PPE is properly cleaned/sanitized prior to storage

# A Key to Success!

- Wearing the proper PPE!
  - Most mishaps occur when either the wrong protective glove is worn or the glove is taken off before the work is complete
  - Work Center Supervisors MUST be the first line of enforcement

# Another Key to Success

- Make sure your gloves are in good condition!
  - Make sure you “pre-check” gloves!
    - Check for cracks, pin holes, degradation, etc.
  - If chemical resistant gloves can’t be cleaned, discard them and order a new pair
  - Dispose of “disposable” gloves

# General Precautions

- Ensure you have the correct type of chemical protective glove for the task
- Thoroughly inspect gloves prior to use
- Wash hands once gloves have been removed
- Once removed, disposable gloves should be discarded
- Non-disposable/reusable gloves may be washed, as needed, and then inspected for tears, holes, degradation, and other damage
- Remove gloves before touching personal items, such as phones, computers, pens, doorknobs, etc.
- If a glove fails and hazardous chemicals come into contact with skin, seek medical attention as needed and inform your supervisor and the command Safety Manager/Officer

# Feedback

- If you identify problems with PPE recommendations in the MRC, NSTM 670 HMUG, or other references:

- Submit a feedback report using the appropriate form (usually in the reference itself) so that the problem can be resolved

# Other Chemical Hand Protection Resources

- Federal OSHA PPE Guide (link in notes)
- NIOSH Skin Exposures and Effects webpage (link in notes)
- Chemical resistant glove manufacturer websites

# *And Now for a Test!*

- Did this sailor make a good glove choice?

- Bonus Points: What about his other PPE choice(s)?  Why?

**If you have questions or comments regarding this presentation please contact the Naval Safety Center feedback line:**

safe-oshfdbk@navy.mil

If you don't know,asl